The revolutions made in the second, 3rd, and $n$th hours are, therefore,

$$(\sqrt{9\pi}+\sqrt{9\pi-1})(\sqrt{9\pi-1}-\sqrt{9\pi-2})\ a,$$
$$(\sqrt{9\pi}+\sqrt{9\pi-1})(\sqrt{9\pi-2}-\sqrt{9\pi-3})\ a,$$
$$(\sqrt{9\pi}+\sqrt{9\pi-1})(\sqrt{9\pi-n+1}-\sqrt{9\pi-n})\ a, \text{ respectively.}$$

The time required to grind away all of the stone is given by the equation, $\sqrt{9-\frac{n}{\pi}}=\frac{3}{4}$, from which $n=\frac{135\pi}{16}$, the number of hours.

Similarly, the number of revolutions made by the smaller stone during the $n$th hour is found to be $\frac{1}{8}(\sqrt{81\pi}+\sqrt{81\pi-8})(\sqrt{81\pi-8(n-1)}-\sqrt{81\pi-8n})$ $b$, and the time required to grind it away, $\frac{69\pi}{8}$. Therefore the larger wears out first, and at this time the smaller is a cylindrical shell whose thickness is $\frac{3}{4}(\sqrt{\frac{3}{2}}-1)$ inches.

This problem was also solved by *P. H. PHILBRICK*, and *H. W. DRAUGHON*.

**5. Proposed by G. B. M. ZERR, A. M., Principal of High School, Staunton, Virginia.**

A cubic mile of saturated air at 18°C. is cooled to a temperature of 10°C. How many tons of rain will fall?

**Solution by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.**

According to Silliman's Table the weight of the aqueous vapor in a cubic foot of saturated air at 18°C., =64$\frac{2}{5}$°F., =6.663 avoirdupois grains; and the weight of that in a cubic foot of the same kind of air at 10°C., =50°F., =4.089 avoirdupois grains. The difference of these weights is the weight of the rain that will fall from a cubic foot of air. Hence the weight of the rain that will fall from a cubic mile of air is

$$R=\frac{(5280)^3\times1287}{7000\times2000\times500}=27125.776 \text{ tons.}$$

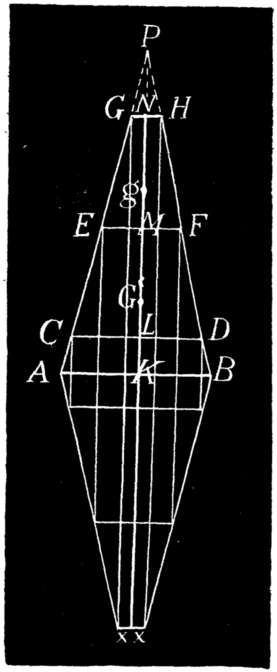
Also solved by the *PROPOSER*.

**6. Proposed by H. C. WHITAKER, B. S., M. E., Professor of Mathematics, Manual Training School, Philadelphia, Pennsylvania.**

Two men wish to buy a grindstone 42 inches in diameter and one foot thick at the center. To what thickness at the outer edge should the stone uniformly taper from the center so that each man may grind off 18 inches of the diameter and both have equal shares, the central six inches of the diameter being waste?

**I. Solution by Professor P. H. PHILBRICK, M. S., C. E, Lake Charles, Louisiana; and A. L. FOOTE, No. 80 Broad Street, New York City.**

Let $ABHG$ represent a half section of the stone through the centre. Draw the centre line $KLMN$; make $KL=3$, $LM=MN=9$ inches; and draw $CD$ and $EF$ parallel to $AB$. Let $GH=x$, and let $G$ and $g$ be the centers of gravity of $CDEF$ and $EFGH$. It is easy to show that,




$$EF=x+\frac{9}{21}\,(12-x)=\frac{4x+36}{7}\ldots.(1),$$

$$\text{and } CD=x+\frac{18}{21}\,(12-x)=\frac{x+72}{7}\ldots.(2).$$

From Mechanics, $GL=\frac{1}{3}\,LM.\,\frac{CD+2EF}{CD+EF}=3.\,\frac{9x+144}{5x+108}$

$$\text{and, } gM=\frac{1}{3}\,MN.\frac{EF+2HG}{EF+HG}=3.\,\frac{18x+36}{11x+36}.$$

$$\therefore\ GK=GL+3=6.\frac{7x+126}{5x+108}\ldots.(3),$$

$$\text{and } gK=gM+12=6.\,\frac{31x+90}{11x+36}\ldots.(4).$$

Let $a$=area of $EFGH$, $A$=area of $CDEF$, and $V$=volume ground off by each man.

$$\text{Now, } A=\tfrac{1}{2}LM\,(CD+EF)=\frac{9}{14}(5x+108)\ldots.(5),$$

$$\text{and } a=\tfrac{1}{2}MN\,(EF+GH)=\frac{9}{14}(11x+36)\ldots.(6).$$

Now, Vol. ground off by the first man = area $EFGH$ multiplied by the circumference of the circle described by radius $Kg$ in revolving about $AB$ as an axis. Hence, $V=2\pi(gK)a\ldots.(7)$.

Similarly, Vol. ground off by the second man = $V=2\pi(GK)A\ldots.(8)$. Substituting in these equations, omitting common factors, and equating we have

$$31x+90=7x+126.\quad \therefore\ x=\frac{3}{2}=1\tfrac{1}{2}\text{ inches.}$$

**II. Solution by SETH PRATT, C. E., Assyria, Michigan.**

1st. Let $2x$= the thickness of the stone at the outer edge. The stone is composed of one cylinder and two cones. $R$=21 inches =the radius of the cylinder and of each cone. Height of cylinder $=2x$. Height of each cone $=6-x$.

$$\text{Content of cylinder }=2R^2n'x=+882n'x.$$

$$\text{Content of the two cones }=R^2n'\tfrac{2}{3}(6-x)=1764n'-294n'x.$$

$$\text{Sum = content of stone }=1764n'+588n'x\ldots.(1).$$

2nd. $R$=12 inches = radius of cylinder and cones.

$$21:12::6-x:h=\frac{24-4x}{7}=\text{height of each cone.}$$

$$12-2h=\frac{36+8x}{7}=\text{height of cylinder}$$

$$\text{Content of cylinder}=R^2n'.\left(\frac{36+8x}{7}\right)=\frac{5184n'}{7}+\frac{1152n'x}{7}.$$

$$\text{Content of cones}=R^2n'.\,\tfrac{2}{3}\left(\frac{24-4x}{7}\right)=\frac{2304n'}{7}-\frac{384n'x}{7}.$$

$$\text{Sum}=\frac{7488n}{7}+\frac{768n'x}{7}\ldots..(2).$$

3rd. $R=3$ inches = radius of cylinder and cones.

$$21 : 3 :: 6-x : h'=\frac{6-x}{7}=\text{height of each cone.}$$

$$12-2h'=\frac{72+2x}{7}=\text{height of cylinder.}$$

$$\text{Content of cylinder}=R^2n'\left(\frac{72+2x}{7}\right)=\frac{648n'}{7}+\frac{18n'x}{7}.$$

$$\text{Content of cones}=R^2n'.\ \tfrac{2}{3}\left(\frac{6-x}{7}\right)=\frac{36n'}{7}-\frac{6n'x}{7}.$$

$$\text{Sum}=\frac{684n'}{7}+\frac{12n'x}{7}\ldots\ldots(3).$$

$$\text{From (1) take (2)}=\frac{4860n'}{7}+\frac{3348n'x}{7}\ldots.(4).$$

$$\text{From (2) take (3)}=\frac{6804n'}{7}+\frac{756n'x}{7}\ldots.(5).$$

Equate (4) and (5) and reduce, and $x=\frac{3}{4}$, or $2x=1\frac{1}{2}$ inches.

Also solved by *H. W. DRAUGHON, H. C. WHITAKER, ALFRED HUME, C. E. MYERS, G. B. M. ZERR*, and *W. L. HARVEY.*

## PROBLEMS.

**10. Proposed by SAMUEL HART WRIGHT, M. D., M. A., Ph. D., Penn Yan, Yates Co., N. Y.**

A small cloud in the S. E. and altitude 70°, was soon after N. 60° E. with an altitude of 30°. In what direction was the wind blowing, the track of the cloud being the arc of a great circle?

**11. Proposed by CHAS. E. MYERS, Canton, Ohio.**

"Assuming the earth's orbit to be a circle, if a comet move in a parabola around the sun and in the plane of the earth's orbit, show that the comet cannot remain within the earth's orbit longer than 78 days."

**12. Proposed by F. P. MATZ, M. S., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.**

If the measures of curvature and tortuosity of a curve be constant at every point of a curve, the curve will be a helix traced on a cylinder.

# QUERIES AND INFORMATION.

**Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.**

**Answer to Queries in the American Mathematical Monthly for March 1894. (Vol. I. No. 3. page 102.)**

I. Omitting Euclid's Parallel-Postulate, but taking for granted all his other postulates and "common notions", it follows by Eu. I. 27, that two coplanar